# THE IMPACT OF THE GRASSLAND HOUSEHOLD CONTRACT RESPONSBILITY SYSTEM ON THE GRASSLAND ECOSYSTEM AND LIVESTOCK PRODUCTIVITY IN G.YON RI, QINGHAI PROVINCE, CHINA

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ABSTRACT

Chinese policy-makers assumed that grasslands were severely degraded by overstocking and overgrazing under the community-based grassland management system from 1981-1991. The Grassland Household Contract Responsibility System (GHCRS) was then implemented. The ecological impact of the GHCRS with its Four Allocations (FA) program on the grassland ecosystem and livestock productivity in G.yon ri Village, a Tibetan agro-pastoral community in Sum mdo Township, Mang ra County, Mtsho lho Tibetan Autonomous Prefecture, Qinghai Province, PR China was studied. Livestock mobility and flexibility, stock diversity, stocking rate, diversity of grass species, grassland enclosure/ fencing and livestock productivity were considered in analyzing the effects of HRCS.

KEY WORDS

G.yon ri Village, grassland household contract responsibility system, livestock productivity, Qinghai, Tibetan Plateau

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## INTRODUCTION

Interviews with G.yon ri herders suggest that they have experienced a number of policy changes affecting grassland use and livestock distribution since the establishment of 'New China' in 1949, as detailed below:

- 1958-1981. Livestock and grasslands were managed under the Commune System,[24] during which all property belonged to the state.

- 1981-1991. The Livestock Household Contract Responsibility System [25] was implemented whereby livestock were distributed among individual households, while grassland was managed by G.yon ri Village, which was also termed Community-based Grassland Management (CBGM).[26]

- 1991-present. An extension of the Household Contract Responsibility System (HCRS),[27] the Grassland Household Responsibility System (GHCRS) [28] was implemented. Individual households may manage and use their grassland allotment, though the state retains land ownership.

CBGM was implemented in the early 1980s in Tibetan pastoral areas when livestock were divided among individual households while the grassland continued to be managed and used communally. When commune rangelands were distributed in the early 1980s, the general pattern was for pastures to be allocated to administrative or natural villages with collective grazing tenure or kin group tenure (Banks et al. 2003). Mountain ranges and rivers were used to demarcate boundaries of

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[24] Gongshe zhidu.
[25] Xumu chengbao daohu zhidu.
[26] Shequ wei jichude caoyuan guanli.
[27] Jiating lianchan chengbao zeren zhidu.
[28] Caoyuan chengbao daohu.

community-owned grasslands. In CBGM, pastoralists moved four or five times annually on the communal grassland as determined by local climate and biophysical characteristics of the grasslands.

In the early 1990s, as an extension of the HCRS for agricultural areas in China, the policy of GHCRS was implemented in most Tibetan pastoral communities. This policy was based on the notion that CBGM leads to a 'tragedy of the commons' that facilitates and promotes a dramatic increase in the stocking rate and grassland degradation through overgrazing. Subsequently, the GHCRS was initiated with the allocation of community grassland to individual herding households, with each household assuming responsibility for its own rangeland parcel.

The GHCRS system, also known as the Four Allocation (FA) program,[29] mandated building a house, fencing, and livestock sheds and cultivating non-native grass species. The central government believed implementation of the GHCRS with its FA would encourage more responsible resource management, improve pastoral productivity, prevent further rangeland deterioration, and protect the grassland ecosystem (Goldstein 1996). The GHCRS aimed to prevent grassland degradation by bringing livestock numbers into balance with the carrying capacity of the grassland. Simultaneously, it was thought that such a system would stabilize livestock numbers by avoiding climate driven mortalities, thus increasing livestock productivity and providing a sustainable income for the pastoralists (Goldstein 1996, Miller 2001).

## THE PROBLEM

Although the GHCRS was implemented with the intention of protecting the grassland ecosystem and improving livestock productivity, certain grassland experts have questioned if sedentizing pastoralists in fenced allotments prevents grassland

[29] Sipeitao jianshe.

degradation (Richard et al. 2006; Miller 2001). Estimates suggest that about 34% of all rangelands in China are moderately to severely degraded, and about 90% are degraded to some degree (Miller 2001). Similarly, Sheehy (2001) writes that about a third of Tibetan Plateau pasture is moderately to severely degraded, questioning its long-term sustainability under contemporary management. Furthermore, interviews and conversations with pastoralists who acted in accordance with the GHCRS of Dge rtse Township, Brag 'go County, Dkar mdze Tibetan Autonomous Prefecture, Sichuan Province, suggest that local herders encounter such problems as insufficient grass, high livestock mortality, and an increase in black sand in grassland areas.

This research seeks to clarify if implementation of GHCRS has improved the grassland ecosystem and livestock productivity in G.yon ri Village. Research was conducted from September to October 2007. More specifically, this research sought to answer these questions:

- What are the environmental impacts of the GHCRS on the grassland ecosystem of G.yon ri Village?
- What are the impacts of the GHCRS on livestock productivity improvement?
- What alternative grassland management techniques might be adopted to prevent further grassland degradation and lead to sustainable grassland use?

## SIGNIFICANCE

Management of rangelands on the Tibetan Plateau has a serious impact on the majority of Tibetans in China. To quote Miller (2004:2):

> Of the Tibetan population in China of about 5 million people, almost 2 million are nomads who make their living primarily from animal husbandry. Another 2 and 2.5 million people are agro-pastoralists, who combine both cropping and livestock raising

> for their livelihoods. As such, livestock development and the management of the rangeland resources are fundamental to the future development of the majority of the Tibetan people.

Furthermore, it also impacts people living in lowland China and neighboring countries (Miller 2001) because this region contains the headwaters of the Rma chu (Yellow), Rdza chu (Mekong), and 'Bri chu (Yangzi) rivers. What occurs on the Tibetan Plateau therefore significantly impacts millions of people.

Implemented rangeland management policies and programs on the Tibetan Plateau should be sustainable and address the need to protect the grassland ecosystem while improving livestock productivity. This study's findings might assist environmental managers and planners in implementing further interventions in herding areas to improve existing rangeland management systems. This research also contributes to the literature on Tibetan rangeland management systems and grassland policies for similar future research.

## G.YON RI VILLAGE

G.yon ri Village had sixty agro-pastoral households (430 Tibetans) in 2007 and is 3,200 meters above sea level. G.yon ri pastoralists live on alpine grasslands where vegetation is sufficient to support a large number of livestock. Pastoralism is their predominant economic activity; fields occupy a small area of their winter pasture. On average, each family has 0.6 hectares of cultivated land. Major income is earned from selling and exchanging such livestock products as butter, wool, hides, and sheep at the local market in Mang ra County Town with Hui and Han businessmen.

During CBGM from 1981-1991, G.yon ri herders used the grassland communally with three seasonal movements. Their livestock moved vertically, grazing in mountain areas in summer, and then moved back to the foot of the mountains in winter. The spring-autumn pasture was located between the summer and

winter pastures. G.yon ri Village also had public pasture owned by the twelve natural villages of Sum mdo Township, where herds grazed for short periods before moving to the winter pasture. During CBGM, flexibility and livestock mobility were considered key strategies in managing livestock grazing.

The GHCRS was implemented in 1991. Community grassland was allocated to individual households with the stipulation that each individual grassland parcel be fenced. The FA implemented in 1991 required villagers to construct houses in the winter pasture. G.yon ri residents then became semi-sedentary with two seasonal livestock movements. G.yon ri residents are required to cultivate non-native grass species in approximately 30% of their farming areas to prevent land erosion and grassland degradation. Residents are not allowed to harvest the planted grass for livestock forage. The government paid 150 RMB per *mu* of farming area as compensation to G.yon ri Villagers.

G.yon ri Village was selected as the study site because it had completed implementing all the FA and strictly followed the GHCRS. In addition, my contacts in G.yon ri made access to information convenient.

## RESULTS AND DISCUSSION

### Mobility and Flexibility of Livestock in G.yon ri Rangeland

The Tibetan Plateau is characterized by highly unpredictable periods of spring drought that retard grass growth and severe snowstorms that destroy herds (Miller 2001). Livestock mobility and rational grazing patterns have been key strategies to avoid climate-driven mortalities, develop long-term livestock production, and to ensure sustainable rangeland usage. Spatial movement of livestock over grassland has been constrained in G.yon ri, reducing herders' flexibility and mobility under the privatization policy.

Traditionally, local herders moved livestock according to seasonal changes. Patterns of livestock movement were

determined by blizzards, excess rainfall, and amount of forage in each pasture, e.g., early snow might have led herders to move from their summer to winter pasture earlier than usual.

During CBGM, herders moved vertically five times a year (Figure 1). They spent from November to March-April in plains areas at lower elevation, and moved into mountain areas for the rest of the year. They spent two to three months in each of the summer, middle, and public pastures. The middle pasture is at about 3,200 meters – around 500 meters lower than the summer pasture. Thus, when herders confronted a lack of forage and heavy rain in summer, they moved to the fall pasture, before proceeding to the public pasture, because the fall pasture has higher grass density compared to the public pasture.

After implementation of the GHCRS, livestock movement was reduced; herders moved only twice annually, between summer and winter pastures. The three former seasonal pastures were combined and divided among individual households for the current summer pasture under the GHCRS.

Figure 1. CBM and GHCRS scheduling of seasonal livestock movements, G.yon ri Village.

| CBGM | | GHCRS |
|---|---|---|
| Dates | Seasonal Pasture | Dates |
| 12 November-1 April | winter | 15 April-1 October |
| 1 April -1 June | middle[30] | 1 October-15 April |
| 1 June-1 Sep | summer | |
| 1 September-1 October | middle | |
| 1 October-12 November | public | |

G.yon ri herders spent approximately six months in each of the two seasonal pastures per year after implementation of the GHCRS. From April-October, herders stayed in the summer pasture and moved to the winter pasture in early October, where they spent the rest of the year (Figure 1). Although G.yon ri has

[30] In this case, the middle pasture was used for both fall and spring pastures.

two seasonal pastures, after herding livestock on the summer pasture they moved sheep to the winter pasture, and entrusted their yaks to other villages for a payment of 0.5 RMB per yak per day. This meant each household annually spent about 70 RMB per yak every five months. According to herders, this livestock management scheme is dictated by insufficient forage and grazing areas for both sheep and yaks in their winter pasture. This happened only after implementation of the GHCRS. The herders explained that around 10% of their winter grazing area was used for construction of houses, roads, animal sheds, and planting non-native grass as dictated by the GHCRS. In addition, villagers are not allowed to cut the planted grass or herd livestock inside the planted grass area.

Livestock mobility was reduced to only two seasonal movements, which encouraged high livestock concentration in one area for a longer time, i.e., nearly six months in each pasture. Herders complained of such problems resulting from limited livestock mobility as the limited capacity and time for grass and soil to recover from grazing. The herders commented that a high concentration of livestock and longer stays in one area led to intense competition over desirable forage and consequently, preferred grasses were shorter and less abundant. The herders felt that herding in the same place for nearly six months led to livestock trampling grassland into bare or black sand ground on approximately 5% of their summer pasture.

Reduced spatial livestock mobility was another problem in G.yon ri after implementation of the GHCRS, which resulted in community grassland being divided among individual households and fenced, thus constraining daily grazing on different grassland areas to reduce livestock pressure on different grass species.

G.yon ri's seasonal pastures are located in mountain areas. Herders traditionally utilized various systems to divide daily herding between different locations. According to local elders, a major strategy was to divide the herd according to terrain, e.g., sunny and shady slopes. In winter, snow remained longer on shady slopes, thus herding livestock on sunny slopes was

preferred because snow melted more quickly there. Meanwhile, evaporation on shady slopes was less, providing vegetation with more moisture, meaning shaded locations had denser vegetation than sunny locations.

After implementation of the GHCRS, certain families were assigned grassland parcels on sunny slopes while others were assigned shady slopes. Herders with sunny slopes thus had land with less dense vegetation, while those with shady slopes had land with snow that melted slowly. In addition, only two moves a year created overgrazing, grassland degradation, and increased livestock mortality during cold and snowy seasons. According to locals, five to six yaks and ten to fifteen sheep per household per year die due to heavy snow. Figure 2 illustrates the comparative systems of livestock mobility and flexibility for the CBGM and GHCRS schemes.

Figure 2. Livestock mobility and flexibility in CBGM and GHCRS compared.

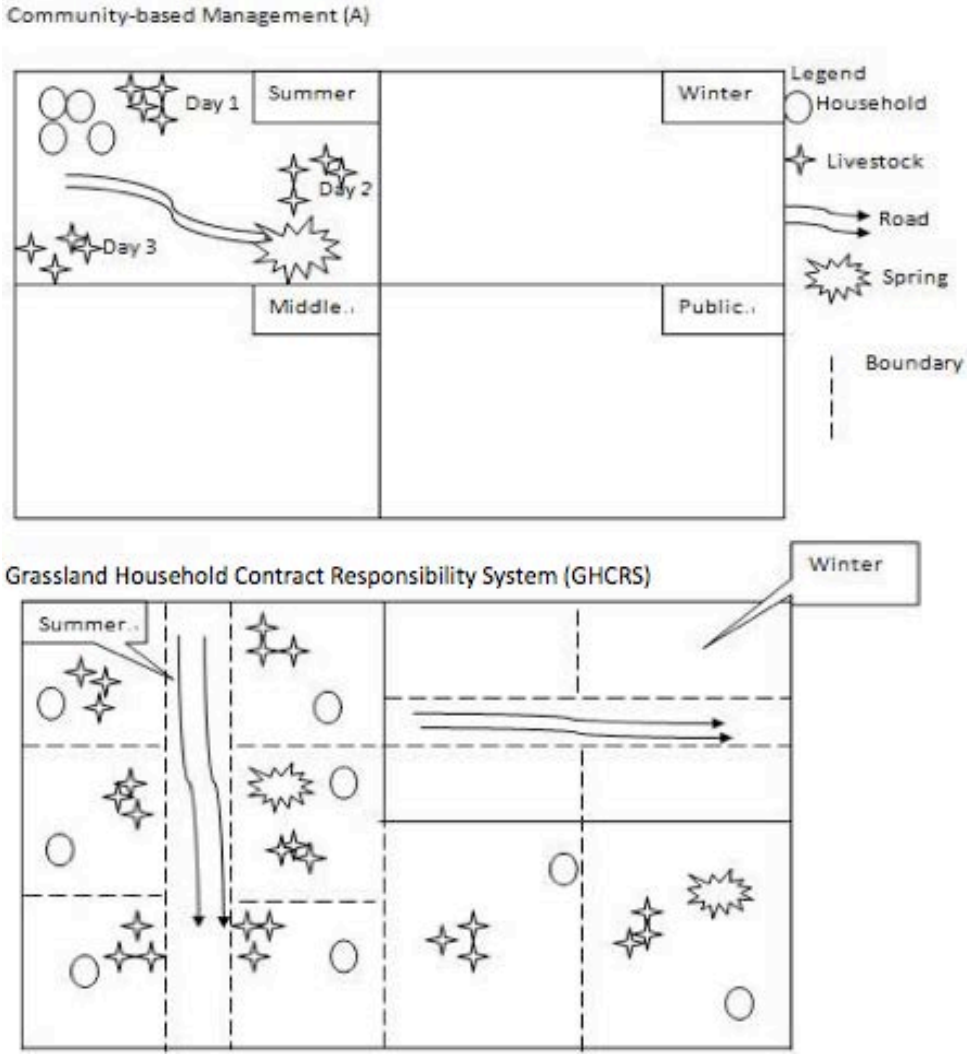



Figure 2A shows that under the CBGM scheme, local herders had choices in terms of livestock mobility and flexibility. These choices included seasonal pastures and different areas for daily livestock grazing, including mobility between sunny and shady areas. For instance, on one day, all the herders might have herded their livestock in upper areas of their summer pasture and the next day might have herded in lower areas, allowing grass

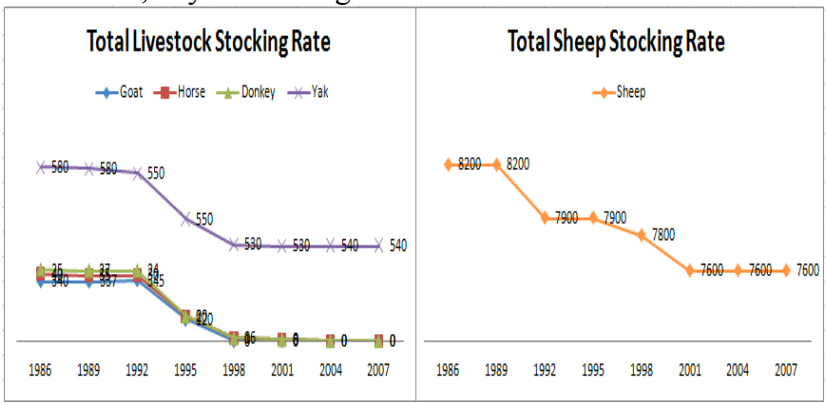
and soil in upper areas to recover. Keppel (2005) observed that high impact of livestock on grassland for short durations is highly beneficial for sustainable growth of grass species because vegetation in the given area receives livestock trampling and disturbance over a short time that facilitates fertilization and seed germination, and when livestock leave the given area for a long period of time, vegetation recovers.

The former summer, middle, and public pastures (Figure 2A) were combined after implementation of the GHCRS in G.yon ri, to create the current summer pasture (see Figure 2B). Individual households were allocated one parcel of grassland in each seasonal pasture. Figure 2B shows that individuals kept their livestock in their assigned parcel, with no daily grazing patterns alternating between sunny and shady slopes. Furthermore, continuous grazing within the individual parcel for nearly six months in each pasture adversely affected the grass and soil. Keppel (2005) reported that plants and soils had no time to recover where there was constant low livestock pressure on the grassland for long periods, resulting in ecosystem damage.

## Livestock Species Diversity

Livestock graze selectively on different species of grass, a fact that pastoralists traditionally used in their management strategies. When herded together, different species of livestock more efficiently use rangeland vegetation. As a result, maintaining livestock diversity is a critical issue for uniform grassland utilization, equal growth of all diverse grass species during the growing season, and efficient use of rangeland vegetation. Furthermore, livestock grazing sustains the grassland ecosystem through trampling, fertilization, and uniform grazing. According to local herders, implementation of the GHCRS both directly and indirectly contributed to a reduction of livestock diversity and rapid decline in grass species diversity since 1991.

Figure 3. Trends in total population of different livestock species 1986-2007, G.yon ri Village.




G.yon ri had yaks, sheep, goats, horses, and donkeys during the CBGM scheme from 1986-1993. Sheep and yaks comprised the majority of both total and productive stock in the late 1980s. Other livestock were utilized for transportation. Livestock diversity was reduced beginning in 1994, about three years after implementation of the GHCRS.

According to local herders, an important reason for livestock diversity reduction was that after implementation of the GHCRS, people concentrated on raising income-generating livestock – yaks and sheep. Horses, goats, and donkeys produce little in the way of commercial products but were used primarily for transportation. The system of keeping diverse livestock species with subsistence-based livestock productivity to maintain sustainable utilization of the grassland ecosystem shifted to income-centered livestock management focused on maximizing marketable livestock products.

Decrease in livestock diversity is also related to reduction in the size of grazing area. Providing grassland allocations to new households was a critical issue after implementation of the GHCRS. During CBGM, communal livestock grazing was managed collectively, and new families herded livestock with others in the common grassland area. However, after the GHCRS, new families received grassland allocations from their parents' privatized rangeland parcels. According to local

township records, approximately twenty new households were established from 1994-2007. Figure 4 provides additional information on the relationship between establishing new households and their use of grassland during community-based and privatization management.

Figure 4. Comparative use of grassland by new families under CBGM and GHCRS.

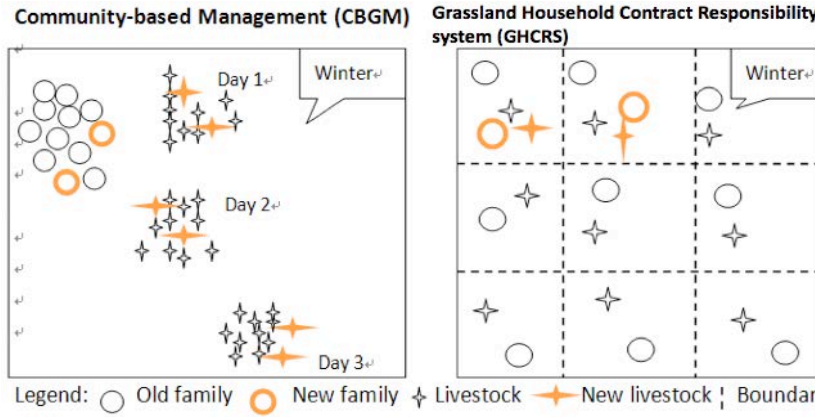
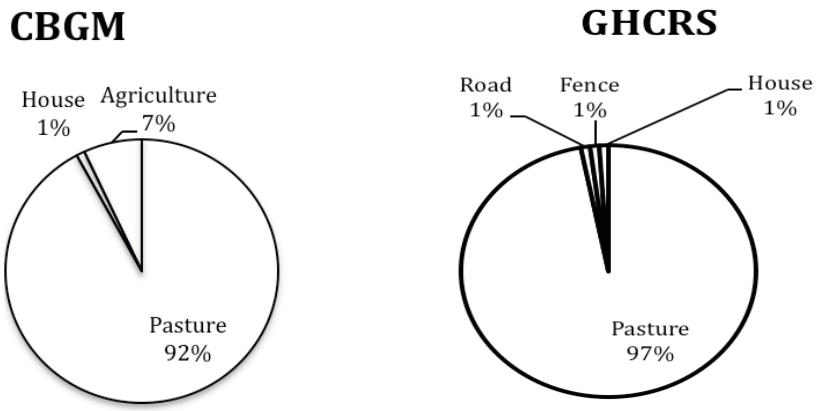



Figure 4 shows that when two new households were added to the total village households during the CBGM period, their livestock were herded with other families on the communal grassland with high daily, seasonal, and spatial movements with minimal livestock pressure on the grassland. However, under the GHCRS, the two new households were allocated grassland from their parents' holdings, thus the pressure of the two new families' livestock was solely on their parents' grassland parcel. As a result, the establishment of nuclear families within a household's original grassland allocation resulted in a high livestock population of longer duration in one area. Therefore, many households with married children reduced livestock diversity due to insufficient grazing area.

Local villagers stated that implementation of the GHCRS reduced access to grazing areas, another cause for reduction of livestock diversity. Figure 5 illustrates the total coverage area of

the FA in comparison to the availability of grazing area during the CBGM and GHCRS.

Figure 5. Allocation schemes of grassland use under CBGM and GHCRS.




G.yon ri has 1,400 hectares of summer pasture (including the former middle, public, and summer pastures), and 2,700 hectares of winter pasture. The government divided 60% of the total land area according to the number of family members, while 40% depended on the total livestock population of each household. In 1991 during the division of the communal grassland, G.yon ri had forty households. One person received 2.7 hectares and one head of livestock received 0.3 hectares of grassland. Figure 5 shows that 93% of the grassland area and 7% of the agricultural land were used for grazing purposes under the CBGM. The farmland was in the winter pasture and was not cultivated in winter. Consequently, the farming areas still functioned as a grazing area, providing forage for livestock in winter. Certain herders said that sheep and goats preferred to graze on harvested fields in late winter.

With FA schemes under the GHCRS, only 90% of the total land area could be used for grazing; the remaining 10% was used for housing, fences, livestock sheds, public roads (see Figure 6), and cultivation of non-native grass.

Figure 6. A public track between two individual households' allocated land holdings in the G.yon ri summer pasture.

Reduction in livestock diversity led to uneven utilization of certain vegetation. Sheep and yaks are selective in what they eat, and areas of their desired forage received high grazing pressure, while undesirable forages were untouched. Consequently, growth of undesirable and noxious species increased, while the total diversity of desirable forage grass species was greatly reduced. Local residents estimate that 20% of summer pasture and 30% of winter pasture were covered by such tall plants as *Achnatherum inebriens* (*chu ge du ka*) which are poisonous, and not eaten by livestock. Herders pointed out that in recent years they realized that keeping only yaks and sheep within one area for nearly six months encouraged high competition over such desirable forage as *Stipa krylovii* (*rtswa 'jam*), leaving other vegetation ungrazed. Desirable forage was overgrazed, leading to black sand patches. Undesirable species likewise started to dominate the grassland ecosystem.

## Diversity of Grass Species in G.yon ri Rangeland

Vegetation diversity is critical to sustaining the grassland ecosystem in the face of livestock grazing and human utilization.

According to Miller (2005), rangelands have been heterogeneous in terms of vegetation species, composition, and productivity, all of which were highly diversified across multiple scales. Grazing helps maintain grass species diversity on the Tibetan Plateau pastures. The privatization policy also aimed to maintain diversified grass species to protect the grassland ecosystem, by bringing livestock population into balance with carrying capacity to prevent grassland degradation through overstocking and overgrazing. Nevertheless, local residents claimed that growth of undesirable vegetation for livestock with few dominant species was common in their pastures and grassland degradation was accelerating.

Figure 7. Major grassland species in G.yon ri Village, their coverage area, and livestock preference.

| Scientific Name | Local Name | Average Coverage Area (%) | Livestock Preference |
|---|---|---|---|
| | | Summer Pasture | |
| *Stipa krylovii* | *rtswa 'jam* | 70 | High |
| *Potentilla anserina* | *gro lung* | 10 | Medium |
| *Rumex* spp. | *rdum bu kho hog* | 8-9 | low or never |
| *Potentilla fruticosa* | *sben ma* | 10 | Never |
| | | Winter Pasture | |
| *Stipa krylovii* | *rtswa 'jam* | 30 | High |
| | *rab'byungs* | 35 | Medium |
| *Leymus* spp. | *'jag ma* | 5-10 | High |
| | *ragdug* | 20 | Low |
| *Achnatherum inebriens* | *chu ge du ka* | 10 | Low |

Figure 7 indicates that *Stipa krylovii* and *rab 'byungs* covered most winter pastures, accounting for around 65% of total land area. Other major grass species included *Achnatherum*

*inebriens, ra gdug,* and *Leymus spp. Stipa krylovii* was categorized as a major forage species in the G.yon ri grassland ecosystem and highly preferred by livestock. According to local herders, *ra gdug* and *Achnatherum inebriens* became prominent in 2000-2001 and are only eaten by horses and yaks during the growing seasons. *Achnatherum inebriens* grows in clumps 1-2 meters apart with strongly attached roots, while *ra gdug* grows individually 2-3 meters apart. *Achnatherum inebriens* and *ra gdug* are toxic to livestock, causing intestinal distress. *Stipa krylovii* and *Leymus* spp. were highly preferred and effective in maintaining livestock health. However, the density and distribution of these two species decreased three to four years after GHCRS implementation. Herders noted that *Stipa krylovii* and *Leymus* spp. covered around 65% of the winter pasture; other dominant species covered 40-45% of the winter pasture in 2007.

Residents explained that due to the absence of yaks and horses in the winter pasture, such tall, robust plants as *Achnatherum inebriens* and *ra gdug* have grown while grass species such as *Stipa krylovii* have limited space and chance to grow and mature. Herders kept only sheep in their winter pasture after the GHCRS, stating that this was because of the lack of winter pasture forage. The sheep grazed often on such short and desirable species as *Stipa krylovii*, leaving tall grasses such as *Achnatherum inebriens* ungrazed. These undesirable species continued to grow without being grazed, while desired ones received heavy pressure due to the longer presence of livestock grazing in the same place. In addition, without yaks, horses, donkeys, and goats grazing in the winter pasture, large amounts of vegetation and their fallen leaves remained.

Long (2003) noted that an increase in the accumulation of dead materials reduces forage growth and yield because such materials create shade, and the photosynthetic capacity of other plants is reduced. Further, livestock concentration for longer duration in a single area promoted formation of bare ground. Herders believed that when the ground becomes barren or has very limited vegetation density, the seeds of *Achnatherum*

*inebriens* and other tall species easily find their way into the soil and regenerate with high density.

In the summer pasture, *Stipa krylovii* covered 70% of the total grassland area while such other major species as *Potentilla anserina*, *Rumex* spp., and *Potentilla fruticosa* comprised 20% of the coverage area. Based on interviews, *Rumex* spp. and *Potentilla fruticosa* grew in certain parcels of the individual grassland areas without uniform coverage and livestock did not prefer either of these species. *Rumex* spp. is poisonous and kills weak and young livestock, while *Potentilla fruticosa* is a shrub livestock avoid eating. The growth of *Potentilla fruticosa* began in 2000, while *Rumex* spp. has grown since 1998. *Rumex* spp. was new to the pastoralists, who have limited knowledge of its forage properties, including its effect on livestock growth and on other vegetation.

Local herders state that after implementation of the GHCRS, they had to stay in the summer pasture without seasonal or daily livestock movement between different pastures. Consequently, when yaks and sheep finished grazing on *Stipa krylovii* and *Potentilla anserina*, they began grazing on *Rumex* spp., which made livestock ill. Each family lost two to three yaks and sheep per year from consumption of poisonous vegetation. Similarly, black sand patches formed from the higher livestock concentration for longer duration, and seeds of *Potentilla fruticosa* easily spread into the soil and germinated. Certain families interviewed said that approximately 50% of their summer pasture had so much *Potentilla fruticosa* that the grassland could no longer be used to graze yaks.

Long (2003) stated that rangeland degradation was often evident with a decreased diversity of plant species and an increase in undesirable and unpalatable grass species. This further indicated the presence of toxic species, and resulted in a reduction of vegetative cover. These were all obvious in the research area in both winter and summer pastures. The actual implementation of the GHCRS created significant changes in the timing of livestock grazing intensity and spatial livestock distribution. As a result, undesirable, toxic, and new species were

easily identifiable in both winter and summer pastures. Likewise, only a few species often dominated in the winter pasture.

## Grassland Fencing/ Enclosure on the G.yon ri Rangeland

The fencing program ignores the fact that herders dwell in highly unpredictable environments where natural disasters are common and devastating to herds. The reality of unpredictable environmental disturbances has led grassland experts to conclude that livestock number is controlled by such climatic factors as snowstorms rather than by limits on the grazing area. After fencing systems were installed in tandem with the privatization policy, this study found that fence construction was central to grazing area degradation.

Based on interviews, all households were expected to have wire fences on their individual grassland parcels. One meter of wire fence cost two RMB and each family spent an average of 30,000 RMB on fencing between 1991 and 1993. After implementation of the GHCRS, individual grassland boundaries became important and fences were needed to delineate the individual land holdings and avoid conflict over boundaries. Fencing all individual grassland parcels with wire fencing was expensive. Consequently, herders used wire-mesh fence, dirt walls, sod walls, and ditches. Figure 8 shows fences that have been built.

Figure 8. Fences used in G.yon ri – barbwire (top left), sod walls (top right), ditches (lower left), and dirt walls (lower right).

The impact of fencing on the land was a major concern. Dirt walls are one meter wide and another one meter of ground must be dug to make a wall as shown in Figure 8. Thus, the dirt wall required strips two meters wide. According to local villagers, dirt walls occupy approximately 100 hectares of winter pasture and fifty hectares of summer pasture.

Sod walls have more serious consequences and are not employed unless deemed absolutely necessary, and there is sufficient grassland area. Such walls are often made to create a sheep yard. In the process, herders dig a half-meter deep and a half-meter wide trench in the grassland. When the sod separates from the ground, it becomes a sod brick, strengthened by roots. Herders use such bricks to make a fence about one meter in height, to fence their individual grassland areas (Figure 9).

Figure 9. A grassland area used to produce sod bricks (A), and a sod brick wall/ fence (B).

(A) (B)

A major problem with sod walls is the formation of bare ground after bricks are removed. Herders believe the ground dug up for fencing remains bare for five to ten years before fully recovering. Figure 9 shows a grassland area dug for sod bricks in 1991. The photo was taken in the winter pasture of G.yon ri Village in 2007. The vegetation remained sparse and the area had not fully recovered in 2007. Each household's private grassland parcel had two or three black sand patches of five to ten square meters in area in 2007. Such problems were more prominent in the winter pastures since they are located in a relatively flat area and it was easier to construct such walls there. Many herders and community leaders were anxious about such patches and believed that livestock trampling these areas for long periods expanded their size.

Herders estimated that the grassland area used for construction of different fences covered approximately seventy hectares, or about 2% of their total land area. Although the purpose of fencing was to prevent grassland degradation by bringing the livestock population into balance with the land's carrying capacity, the impact of collecting materials to produce these fences seriously damaged large areas of grassland.

Government documents suggest privatization shifts pastoralism from disequilibrium and opportunistic management to a balance between the carrying capacity of the grassland area and livestock number (Goldstein 1996). The government's subsequent implementation of FA under the GHCRS aimed to reduce climate-driven mortality of livestock, prevent grassland degradation, and improve livestock productivity to increase herders' income.

According to locals, butter and wool are major livestock products. Therefore, production data on these commodities were collected. Butter and wool produced per head of livestock during the CBGM and upon implementation of the GHCRS were compared and are presented in Figure 10.

Figure 10. Amounts of butter (kg) and wool (kg) produced per head of livestock during CBGM and GHCRS.

| | CBGM | | | GHCRS | | |
|---|---|---|---|---|---|---|
| Families | Total Livestock | Total Product | Product Per Head | Total Livestock | Total Product | Product Per Head |
| | Yaks | Butter | Butter | Yaks | Butter | Butter |
| Rich | 20 | 70 | 5.5 | 40 | 100 | 4.5 |
| Medium | 14 | 50 | 4.7 | 20 | 80 | 4.0 |
| Poor | 8 | 80 | 5.0 | 28 | 150 | 3.4 |
| | Sheep | Wool | Wool | Sheep | Wool | Wool |
| Rich | 250 | 500 | 2.0 | 350 | 595 | 1.7 |
| Medium | 150 | 500 | 3.3 | 160 | 450 | 2.8 |
| Poor | 109 | 216 | 2.0 | 240 | 360 | 1.5 |

Figure 10 shows that the average amount of butter and wool produced per head of livestock declined after implementation of the GHCRS. As shown, a rich family produced an average of 5.5 kilograms of butter from one female yak during CBGM. This fell to 4.5 kilograms after

implementation of the GHCRS. Medium-income and poor families confronted a similar decline in butter production. Similarly, the average production of wool from one head of sheep fell after the GHCRS. During CBGM, a medium-income family produced 3.3 kilograms of wool per head of sheep, which fell to 2.8 kilograms after implementation of the GHCRS.

According to local leaders and township officials, all G.yon ri households completed the stipulations of the FA in 1996, after three years of promulgating the GHCRS. Consequently, locals should have gained clear benefits. However, study results suggest that the average productivity per head of livestock fell for most families. Only three respondents cited no change in livestock productivity. The implementation of FA thus cannot be positively correlated with livestock productivity improvement in G.yon ri Village.

Interviewees suggested that the major reasons for reduction in livestock productivity were insufficient forage, growth of undesirable vegetation, limited access to water for livestock, and limited mobility and flexibility to avoid such calamities as blizzards. According to locals and grassland experts, adequate supplies of drinking water are crucial to maintain livestock health and increase their productivity. Locals complained that fencing and privatization of grassland prevented easy access to water resources and created inconvenience for many households.

G.yon ri has two streams in the summer pasture and one major river in the winter pasture, which flows on the north side of the Mang ra County seat. Both humans and livestock obtained drinking water from these sources. However, after grassland fencing, the two streams in the summer pasture were incorporated into two families' grassland allocations. Fencing prevented other families' livestock from accessing these water sources, creating critical problems for local households. Figure 11 shows a main stream in the summer pasture located inside a household's fenced area.

Figure 11. A stream inside a fenced area in G.yon ri Village summer pasture.

Locals reported conflict over water access. After fencing, it was impossible to move livestock to water sources without damaging fences. Consequently, the only source of water available for most families was a spring near a public road two to three kilometers away. Villagers used donkeys and male yaks to fetch water for livestock. During the traditional CBGM scheme, locals reported watering their livestock three times daily, as compared to 2007 when it was difficult to provide livestock with water even once a day.

To further clarify the effects of the GHCRS with FA on livestock productivity, an analysis of village stocking rate in correlation with the implementation of FA under the GHCRS was applied. Yaks and sheep were major sources of livestock products. The implementation of the GHCRS with its FA was meant to protect livestock from climate driven mortality and to stabilize the stocking rate for sustainable and increased productivity and ultimately increase nomads' income by providing extra forage, livestock sheds during cold seasons, and privatization and fencing of grassland to promote more responsible management. Thus, implementation of the FA was expected to be positively correlated with stabilized livestock population with no fluctuations over time.

Figure 12. Total G.yon ri yak population, 1986-2007.

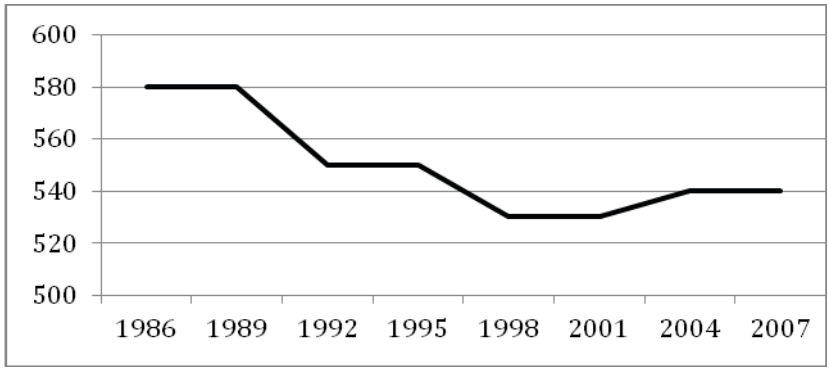



Figure 12 shows that the yak-stocking rate in G.yon ri was reduced at the beginning of GHCRS implementation in 1991, and remained stable for three years before increasing in 2001. The yak population fluctuated within the privatization period of 1991-2007. According to locals, weather disasters, toxic forage, and insufficient livestock forage accompanied by grassland degradation are major causes of livestock death.

The aims of the GHCRS to reduce climate-driven mortalities of livestock and to stabilize the stocking rate after it balanced with the carrying capacity were not realized. Total livestock number continued to fluctuate from 1991 to 2007. Grassland privatization management failed to improve average livestock productivity.

Butter and wool production figures, as well as the stocking rate, indicate that fencing grassland in conjunction with other programs under the grassland privatization policy failed to achieve initial objectives to increase and sustain livestock productivity.

## RECOMMENDATIONS

The following recommendations are made to improve livestock and grassland management under the privatization policy based on the case of G.yon ri.

## Policy

Livestock mobility and flexibility were reduced to only two seasonal movements. Daily movements were also reduced within seasonal pastures. These problems have been demonstrated to negatively impact the grassland ecosystem and livestock productivity, and should be addressed by:

- Dividing the current summer pasture into two seasonal pastures to increase livestock mobility and flexibility.
- Sharing individual grazing parcels within each seasonal pasture among kin groups i.e., five or six families in a collective herding group. This strategy would encourage daily movement of livestock grazing in a wider grassland area so that livestock have more land on which to move.

## Pasture

GHCRS with its FA did not allow herders to graze their yaks inside the planted-grass areas, thus, total grazing area was reduced. This should be addressed by planting native grass species and forage preferred by livestock, and harvesting them annually to provide livestock forage, especially during inclement weather.

## Advocacy

The major income source was from livestock products, which led local residents to reserve available grazing areas for yaks and sheep, the major source of their livelihood. However, the study showed a reduction in wool and butter production. Consequently, the herders' desire to increase the stocking rate for the improvement of the total livestock productivity put even greater pressure on the grassland ecosystem. Therefore, access to

education and vocational skill training are recommended to increase economic opportunities.

G.yon ri herders had a large sheep population, but few skills to utilize wool to produce commercially viable products. Training in using wool to make sweaters and carpets is recommended.

Assisting G.yon ri herders to establish small-scale herding cooperatives to conduct small business enterprises is also recommended to provide alternative income sources for herders and offer opportunity to undertake small-scale enterprises. A follow-up study tour and training are suggested for cooperative members to better understand small-scale enterprises.

## Extension of the Study

This research focused on the impact of privatization policy on grassland protection and livestock productivity. *Achnatherum inebriens* and *Rumex* spp. have toxic effects on livestock, and their coverage was expanding. Future studies could be done on strategies to control these toxic plants.

Certain elders mentioned that in the past, wildlife passed through their winter pastures to the riverbank for water. However, no wildlife had been seen passing near their grassland since the 1970s. They assumed that fences blocked the wild animals. More study is needed on fencing and wildlife interaction.

According to Shikui et al. (2000), shrubs provide protein that improves livestock productivity. However, this study suggests that livestock rarely graze on *Potentilla fruticosa* (a shrub), which covers much grassland once available for grazing. Further studies might establish what shrubs can be planted as an alternative protein supplement to improve livestock productivity.

# CONCLUSION

The first objective of the study was to see if the GHCRS improved the G.yon ri grassland ecosystem. Findings showed a reduction in livestock mobility and flexibility, diversity of grass and livestock species, and the size of grazing areas. It also showed that construction of fences damaged large areas of grassland. In addition, undesirable and toxic species came to dominate the grassland ecosystem. Areas with desirable forage received high concentrations of livestock grazing for long periods. Likewise, bare, black sand patches formed in each individual pasture. The study can only conclude that implementation of the GHCRS did not improve the G.yon ri grassland ecosystem but instead led to negative effects promoting further grassland degradation.

The second objective was to see if the GHCRS improved average livestock productivity. Data showed that average production of butter and wool fell and the yak population fluctuated. The policy aim to reduce climate-driven mortality of livestock was not achieved. This study thus concludes that implementation of the privatization policy did not improve livestock productivity in G.yon ri.

However, the grassland privatization policy has had positive consequences in terms of certain social, economic, and environmental aspects. For instance, dividing the grassland between individual households with fences saved time and labor of child herders who attended school. Otherwise, they spent ten to twelve hours daily herding livestock. Adult herders were able to engage in alternative economic activities. Similarly, individualizing communal grassland provided equal grazing access to poor and rich families. During the study, certain poor families who had few livestock stated that they could rent their extra grassland. In addition, with no seasonal movements and construction of houses in winter pastures, travelling difficulties for old and disabled people were reduced. Further studies are needed for a more holistic view of pastoralism and privatization policies.

Figure 13. *Stipa krylovii* (*rtswa 'jam*).

Figure 14. *Potentilla anserina* (*gro lung*).

Figure 15. *Potentilla fruticosa* (*sben ma*).

Figure 16. *Rumex spp.* (*rdum bu kho hog)*.

Figure 17. *Ra gdug*

Figure 18. *Leymus spp.* (*'jag ma)*.

Figure 19. *Achnatherum inebriens* (*chu ge du ka)*.